CLAIMS

1. A semiconductor laser device including at least one portion which has been Quantum Well Intermixed (QWI), the device also including means for providing gain profiling.

2. A semiconductor laser device as claimed in claim 1, wherein the device also provides a slab wide optical waveguide (WOW).

3. A semiconductor laser device as claimed in claim 1, wherein the semiconductor laser device is fabricated at least partly from compound semiconductor materials.

4. A semiconductor laser device as claimed in claim 3, wherein the compound semiconductor materials are III-V semiconductor based materials.

5. A semiconductor laser device as claimed in claim 4, wherein the III-V semiconductor based materials comprise Gallium Arsenide (GaAs) based materials.

6. A semiconductor laser device as claimed in claim 4, wherein the III-V semiconductor based materials include Aluminium Gallium Indium Phosphide (AlGaInP).

7. A semiconductor laser device as claimed in claim 1,

wherein the semiconductor laser device comprises a multiple layer wafer structure.

8. A semiconductor laser device as claimed in claim 7, wherein the multiple layer wafer structure incorporates an optical waveguide comprising an undoped high refractive index core region containing at least one Quantum Well (QW) as-grown, and bounding the core region doped cladding regions having lower refractive indices than the core region.

9. A semiconductor laser device as claimed in claim 8, wherein the laser wafer structure contains at least one Quantum Well layer structure as grown, and is grown on a (100) Si doped GaAs substrate misorientated 10° to the [111] A direction.

10. A semiconductor laser device as claimed in claim 8, wherein the Quantum Well layers comprise at least one double Quantum Well layer.

11. A semiconductor laser device as claimed in claim 10, wherein the Quantum Well layers have an emission wavelength as-grown of the order of 670ηm.

12. A semiconductor laser device as claimed in claim 7, wherein the multiple layer wafer structure consists of an Si doped GaAs buffer layer, an n-doped low refractive index waveguide cladding layer, an undoped high refractive index

waveguide core layer, a p-doped cladding layer, a p-doped low refractive index barrier reduction layer, a p^{++} doped GaAs capping layer, a dielectric insulation layer and a p-type contact.

13. A semiconductor laser device as claimed in claim 7, wherein the multiple structure consists of a 500nm Si doped ($3x10^{18}cm^{-3}$) GaAs buffer layer, a 1.0μm Si ($6x10^{17}cm^{-3}$) doped $(Al_{0.7}Ga_{0.3})_{0.5}In_{0.5}P$ lower waveguide cladding layer, a 600nm undoped $(Al_{0.3}Ga_{0.7})_{0.5}In_{0.5}P$ waveguide core layer, a 1.0μm Zn ($6x10^{17}cm^{-3}$) doped $(Al_{0.7}Ga_{0.3})_{0.5}In_{0.5}P$ cladding layer, a Zn ($2x10^{18}cm^{-3}$) doped $Ga_{0.5}I_{n0.5}P$ barrier reduction layer and a 300nm Zn ($>1x10^{19}cm^{-3}$) doped GaAs capping layer.

14. A semiconductor laser device according to claims 8, wherein a number of low band-gap Quantum Wells are substantially centrally placed in the undoped core region.

15. A semiconductor laser device as claimed in claim 14, wherein the low band-gap Quantum Wells comprise two strained 6.8nm wide $Ga_{0.5}In_{0.5}P$ Quantum Wells and an undoped layer comprising a 15nm $(Al_{0.3}Ga_{0.7})_{0.5}In_{0.5}P$ barrier.

16. A semiconductor laser device as claimed in claim 1 , which consists of three separate portions:

first and second at least one portions which are Quantum Well Intermixed (QWI) and optically passive, and

a mid portion between the first and second at least one portions which is optically active and includes at

least one Quantum Well.

17. A semiconductor laser device as claimed in claim 16, wherein there is provided means for injecting current into the mid portion thereby providing optical gain profiling in the device in use.

18. A semiconductor laser device as claimed in claim 17, wherein the current injection means is shaped as a geometric pattern, the shape of the contact being selected to allow for matching of the optical mode and gain of the device.

19. A semiconductor laser device as claimed in claim 18, wherein the contact is shaped in a half-tone, finger pattern, triangular or Gaussian distribution.

20. A semiconductor laser device as claimed in claim 16, wherein the first at least one portion acts, in use, as a Non-Absorbing Mirror (NAM)allowing and the second at least one portion acts in use, as a spatial filter.

21. A semiconductor laser device as claimed in claim 16, wherein the first and second at least one portions acts, in use, as Non-Absorbing Mirrors (NAM).

22. A semiconductor laser device providing gain profiling and Quantum Well Intermixing (QWI).

23. A method of fabricating a semiconductor laser device according to any of claims 1 to 22, the method comprising:

(a) providing a laser device body portion including at least one Quantum Well;

(b) defining on the device body portion at least one portion to be intermixed and intermixing the Quantum Wells (QWs) within the at least one portion; and further

(c) defining on the device body portion at least one optically active region and providing current injection means associated with the at least one optically active region.

24. A method of fabricating a semiconductor laser device as claimed in claim 23, wherein the intermixing step is selected from Impurity Induced Disordering or Impurity Free Vacancy Disordering (IFVD).

25. A method of fabricating a semiconductor laser device as claimed in claim 24, wherein IFVD includes deposition of a dielectric layer on the device body portion, and subsequent rapid thermal annealing causes semiconductor material to dissolve into the dielectric layer thereby leaving vacancies in semiconductor material of the device body.

26. A method of fabricating a semiconductor laser device as claimed in claim 25, wherein the device body portion comprises a multiple layer wafer structure grown by Metal-

Organic Vapour Phase Epitaxy using a large III - V growth ratio or by Molecular Beam Epitaxy (MBE).

27. An apparatus including at least one device according to any of claims 1 to 22.

28. An apparatus as claimed in claim 27, wherein the apparatus is selected from a CD ROM or CD player, or a telecommunications apparatus.

29. A system including at least one device according to any of claims 1 to 22.

30. A system as claimed in claim 29, wherein the system comprises a telecommunications system.